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ON THE COLLOID-CHEMICAL ACTION OF THE  
DIURETIC SALTS<sup>1</sup>

THIS paper reports a further series of experiments on rabbits which show that *the colloids of the cells and of the juices which bathe them (blood and lymph), and the state in which these exist determine in the main the amount of water such cells and body fluids hold under both normal and abnormal conditions.*

The maintenance of a urinary secretion depends upon two factors, first, upon a supply to the kidney of "free" water out of which to make urine, and second, upon the ability of the kidney cells to do the work necessary in transferring the water from the blood into the uriniferous tubules. Urinary secretion may fail through interference with either of these factors.

The intravenous injection of any amount of blood, blood serum, or a hydrophilic colloid in which all the water is bound to the colloid, is followed by no increase in urinary secretion. This is because no "free" water is given. The same amount of water when given "free," as in the form of a saline solution, is followed by a prompt increase in urinary flow.

When equal amounts of sodium chloride solution are injected we get increasingly greater amounts of urine with progressive increase in concentration of the salt. This is because the salt dehydrates the body tissues, and the "free" water thus obtained is added to that which is being injected. The salt owes its action as a diuretic primarily not to any effect upon the kidney, but to its action in dehydrating the colloids of the whole body.

When equal amounts of equimolecular solutions of different salts are injected it is found that the order in which these produce diuresis is the same as the order in which they dehydrate (protein) colloids. Thus in a series of chlorides the metals arrange themselves in the following order, in which that most powerful in producing a diuresis is named last: sodium, magnesium, strontium, calcium. In a series of sodium salts the acid radicals arrange

themselves as follows: chloride, nitrate (?), bromide, iodide, acetate, phosphate, sulphate. The greatest diuresis of all is produced by a salt which is made up of a powerfully dehydrating base with a powerfully dehydrating acid, for example, magnesium sulphate.

*The diuretic action of these different salts parallels completely their dehydrating effect upon (protein) colloids, a fact which again indicates that they owe their action primarily to their effect upon the body as a whole, acting as diuretics only as they furnish a working kidney "free" water.*

The experiments also betray no evidence of an antagonism between monovalent salts such as those of sodium, and bivalent salts such as those of calcium, strontium, etc. Such salts act *synergetically*, not antagonistically, in physiological reactions, just as they do in test-tube experiments on simple protein colloids.

It is impossible to explain these salt effects upon any osmotic basis, for there exists not even the grossest parallelism between the physiological effect and the osmotic pressure of the solutions employed. Our critics have maintained that osmotic phenomena dominate the picture of absorption and secretion in "living" tissues. They have grown willing to grant that the colloidal theory is operative in "dead" tissues. In the described experiments the osmotic element can hardly be found; the colloidal element appears plainly in every one of them. It is needless to add that our rabbits were alive.

The detailed laboratory findings upon which this article is based have been submitted for publication in the *Kolloid Zeitschrift*.

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## SOCIETIES AND ACADEMIES

## THE AMERICAN MATHEMATICAL SOCIETY

THE one hundred and sixty-third regular meeting of the American Mathematical Society was held at Columbia University on Saturday, April 26, extending through the usual morning and

<sup>1</sup> A preliminary communication.

afternoon sessions. The attendance included fifty-seven members. President E. B. Van Vleck occupied the chair, being relieved by Ex-Presidents H. S. White and T. S. Fiske. The following new members were elected: Professor E. H. Jones, Daniel Baker College; Mr. L. B. Robinson, Johns Hopkins University; Dr. H. M. Sheffer, Cornell University; Dr. W. B. Stone, University of Michigan; Professor F. B. Wiley, Denison University. Six applications for membership were received. Professors D. R. Curtiss and P. F. Smith were elected members of the editorial board of the *Transactions* to succeed Professors Böcher and White, who retire in the fall.

The following papers were read at this meeting:

E. L. Dodd: "The error risk of the median compared with that of the arithmetic mean."

B. M. Batchelder: "The divergent series satisfying linear difference equations of the second order."

P. M. Batchelder: "The hypergeometric difference equation."

H. J. Ettlinger: "On a generalization of a Sturmian boundary problem."

R. L. Moore: "Concerning pseudo-Archimedean and Vollständigkeit axioms."

J. E. Rowe: "The relation between the pencil of tangents from a point to a rational plane curve and their parameters."

E. G. Bill: "Analytic curves in non-euclidean space (third paper)."

Joseph Slepian: "On the functions of a complex variable defined by a differential equation of the first order and the first degree."

Nathan Altshiller: "On the cubic with a double point."

C. F. Craig: "Ruled surfaces associated with certain rational space curves."

H. M. Sheffer: "The generalized principle of duality in Boolean algebras."

T. H. Gronwall: "On the maximum modulus of an analytic function."

L. L. Smail: "Note on the summability of properly divergent series."

Maurice Fréchet: "Sur les classes V normales."

Maxime Böcher: "An application of the conception of adjoint systems."

G. D. Birkhoff: "Note on the gamma function."

G. D. Birkhoff: "Solution of the generalized Riemann problem for linear differential equations, and of the analogous problem for linear difference and  $q$ -difference equations."

L. P. Eisenhart: "Transformations of Guichard."

E. V. Huntington: "Sets of independent postulates for betweenness (second paper)."

A. D. Pitcher: "On the connection of an abstract set, with applications to the theory of functions of a general variable."

A. D. Pitcher: "Concerning the property  $\Delta$  of a class of functions."

R. G. D. Richardson: "Oscillation theorems for a system of  $n$  linear self-adjoint partial differential equations of the second order with  $n$  parameters."

H. H. Mitchell: "On some systems of collineation groups."

H. S. Vandiver: "Symmetric functions formed by certain systems of elements of a finite algebra, and their connection with Fermat's quotient and Bernoulli's numbers."

C. A. Fischer: "The derivative of a function of a surface."

C. T. Sullivan: "Properties of surfaces whose asymptotic curves belong to linear complexes."

S. D. Killam: "A note on graphical integration of a function of a complex variable."

K. P. Williams: "On the asymptotic form of the function  $\Psi(x)$ ."

M. G. Gabba: "A set of postulates for general projective geometry in terms of point and transformation."

W. A. Hurwitz: "Postulates sets for abelian groups and fields."

Edward Kasner: "The interpretation of the Appell transformation."

G. M. Green: "Systems of  $k$ -spreads in an  $n$ -space."

J. W. Young: "A new formulation for general algebra."

J. W. Young and F. M. Morgan: "The geometry associated with a certain group of cubic transformations in space."

The summer meeting of the society will be held at the University of Wisconsin, Madison, Wis., during the week September 8-13. The last four days of the week will be devoted to a colloquium, at which courses of lectures will be given by Professor L. E. Dickson, of the University of Chicago, on "Certain aspects of a general theory of invariants, with special consideration of modular invariants and modular geometry"; and by Professor W. F. Osgood, of Harvard University, on "Topics in the theory of analytic functions of several variables."

F. N. COLE,  
Secretary